

INTERDISCIPLINARY RESEARCH PROGRAM

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LONG-TERM GOALS

The long-term goals of this program are to foster interdisciplinary research efforts which combine the research interests of several investigators. In addition, the ARL Program provides partial Laboratory support for post-doctoral students and new academic appointments.

RESEARCH COMPONENTS

Long Time-Scale Ambient Noise Measurements in the Littoral Zone (G.B. Deane)

The focus of this effort is to collect long time-scale measurements of ambient noise in the near shore region in order to study the relationship between surf noise and environment conditions. The data collection system, located approximately 200 m south-west of Scripps pier, records ambient noise levels in the band 10 Hz-22.5 kHz, and coherence in the vertical, horizontal to the shore line and perpendicular to the shore line in the surf zone. There also is a pressure sensor which yields wave height and tide data. The sensor system (SANDE) consisting of 4 hydrophones operating from 10 Hz to 22.5 kHz and a pressure sensor operating from DC to 5 Hz was deployed in early July 1997 and has been recording data since that time.

Optical Laser Measurements of Micron-Sized Bubbles in the Surf Zone (G.B. Deane)

The objective of this effort is to develop a laser imaging system to photograph bubbles in the range 10-100 micrometer radius in the surf zone, and deploy the system in the surf zone in a trial study. The photographic phase of the imaging system has been built and successfully deployed. In addition, an automated system for analyzing digital images has been developed. Currently, the photographic system is being modified to generate digital images. A trial deployment of the digital system was carried out in September 1997.

Acoustic Communication in Shallow Water (W.S. Hodgkiss)

The focus of this research is the investigation of the time-evolving impulse response of the shallow water communications channel in the 10-20 kHz band and the limits it imposes on acoustic data telemetry. Our work has involved the analysis of previously-recorded data in

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this band from an intermediate-depth water experiment involving a ship-deployed source and multiple sonobuoy receivers at ranges of 1-4 km. As an outgrowth of this analysis effort, planning has been done for the collection of a shallow water data set from a fixed source - fixed receiving array experiment to be conducted in early FY98.

Synthetic Vertical Arrays using Expendable Hydrophones (G.L. D'Spain)

The focus of this effort was to study the feasibility of creating vertical underwater acoustic arrays synthetically using one or a few expendable hydrophones that descend (ascend) through the water column. The emphasis was on the ability of synthesized vertical arrays to localize a source in range and depth, and on the ability of synthesized "tilted" arrays (i.e. those with both vertical and horizontal aperture) to determine source position in range, depth, and azimuth. The approach employed was to use existing physical-aperture array data collected during the SWellEx-96 experiment to synthesize synthetic-array data in order to examine a number of issues - e.g. signal processing structures, descent (ascent) rates, etc.

Completion of a Broadband Three-Component Inertial Sensor for Seafloor Compliance Measurements (S.C. Webb and W.C. Crawford)

The objective of this effort was to construct an autonomous instrument which measures three components of seafloor acceleration. The inertial sensor was completed in April 1997. As an engineering and noise level test, the sensor was deployed in 2500 m water on the Juan de Fuca Ridge in May 1997. Noise levels determined from these deployments are low enough to allow vertical and possibly horizontal compliance measurements in the continental shelf environment for which the instrument was designed.

Prototype Coastal Current Monitoring System (R. Pinkel)

The objective of this work is to develop a prototype system with the capability of monitoring coastal currents to ranges in excess of several kilometers. A pair of 50 kHz side scan transducers were acquired previously from ITC. In June 1997, these were used to create a single beam Doppler sonar which was operated from the SIO pier. The purpose of the test was to investigate acoustic propagation conditions in the nearshore in this frequency range. The surprising result of the test was that propagation at 50 kHz appears to be strongly impeded, by unknown processes. Propagation conditions appeared more favorable during periods of low tide, when water depths were reduced by 10%. We are exploring the causes for this finding. Additional tests are planned for Spring 1998.

Enhanced Underwater Optical System Performance (J.S. Jaffe)

The objective of this effort was to enhance our capabilities for making optical measurements underwater. A new type of solid state Nd-YAG laser was acquired which has many advantages for both on-going and new projects in our group. The laser has features which are not available with other types of light sources: (1) The pulsed nature of

the system allows us to look at kinetic processes in measuring photosynthetic efficiency of plants. We were successful in using this instrument to develop a new technique which will allow us to take pictures of the "health" of plants based on a physiological assay. This is a novel result which could not have been obtained with previous CW lasers. (2) The laser provides illumination at a wavelength of 532 nm which is ideal for coastal applications. (3) The laser utilizes standard 110/220 V power and does not require water cooling.

GPS Sensing of Atmospheric Water Vapor from a Coastal Buoy (C.D. Chadwell and F.N. Spiess)

The objective of this work is to evaluate the capability of the Global Positioning System (GPS) to sense atmospheric water vapor at a coastal buoy. The signals propagating from GPS satellites to ground-base GPS receivers are delayed by atmospheric water vapor. At land-based GPS stations, methods to estimate this delay have been developed. Though integrated precipitable water vapor (IPW) measurements are routinely made from static land-based receivers, this capability has not yet been demonstrated in the more complicated dynamic environment of an ocean platform. In FY97, hardware preparations were made to mount a dual frequency geodetic GPS receiver along with air temperature and air pressure sensors on the ONR-SIO Marine Observatory which was moored approximately 4 miles west of the SIO pier on November 4, 1997. Currently, data are being collected to evaluate the ability to estimate IPW at the buoy.

Instrumentation Manipulation on the Sea Floor (Prelim Design) (F.N. Spiess)

The goal of this project is to create a preliminary, conceptual design for a system to operate in conjunction with, or as a modification to, the existing wireline reentry control vehicle (CV) in order to move pieces of equipment with precision on the sea floor. To provide stability the device will rest on the seafloor, being placed and powered from the CV. It will include a crane with about 3 meters reach with a heavy duty grasping device at its extremity, thus allowing it to pick up and adjust reasonably heavy objects involved in various research programs. At this time we are investigating potential components - small cranes and manipulators - and will be selecting appropriate units and continuing design of the seafloor contact portion.

Postdoctoral and New Research Series Appointments (W.A. Kuperman and W.S. Hodgkiss)

The objective of this component of the ARL Program is to encourage research group support of postdoctoral students and to provide partial Laboratory support for new academic appointments. In FY97, two Postgraduate Researchers were supported: (1) Dr. Valerie Ballu in the area of seafloor gravity and (2) Dr. Nicholas Carbone in the area of acoustic communications.

Undergraduate Summer Internship (J.A. Hildebrand)

In FY97, a new summer undergraduate internship component of the ARL Program was established with the objective of introducing undergraduates to oceanographic research relevant to the Navy. Out of a number of applicants, five undergraduates were selected from four different institutions and they spent 10 weeks in residence at SIO working with a MPL research group.